Paper for the Manufacture of Panels and Method of Making the Paper

The invention relates to a method of making a paper for tiles as well as a paper produced according to the method. The invention relates further to panels, in the manufacture of which the paper is used, as well as an associated method of manufacture.

A tile according the invention can be further processed to form a panel. A panel, for example known from the publication EP 090 6994 A1 is as a rule an elongated thin tile, which can be joined laterally, i.e. at its longer and shorter sides, to further panels, for example through tongues and grooves. Panels joined together in this way are used in particular as floor coverings or as wall coverings.

A tile is produced according to the state of the art, amongst other ways, as follows. A paper impregnated with resin, which is called "counter-pull paper" is prepared. A carrier plate is placed over the counter-pull paper. A further resin-impregnated paper is arranged above the plate. The two papers are pressed together with the plate at temperatures around 200° C to form the tile.

The paper which is arranged above the plate is generally provided with decoration or a pattern which determines the appearance of the tile as viewed from above.

Particles of SiC or grains of corundum can be rolled onto the side having the decoration before the pressing step, in order to obtain a tile having a particularly resistant surface. In addition a layer of cellulose is applied to the side having the SiC particles or the corundum.

The paper with the printed decoration is called patterned paper. The cellulose layer is identified as "overlay".

The patterned paper is arranged with the overlay above the carrier plate. The patterned paper is then present between the carrier plate and the overlay. Subsequently the counter-pull paper, carrier plate, patterned paper and overlay are pressed together at a temperature within the range of 200° C. When the laminate system is taken from the press the result is a tile which has on one face a pattern with a particularly hard surface.

Panels having the desired dimensions and with lateral tongues and grooves can be produced from the tiles by sawing and milling. The panels are used in particular as floor coverings.

The carrier plate gives the panel mechanical stability. The decoration on the patterned paper determines the appearance of the subsequent wall or floor surface. The layer of corundum or SiC_2 provides good resistance to abrasion and the like. The counter-pull paper opposes distortion of the carrier plate. The overlay protects one surface of the press from the otherwise projecting hard grains of SiC_2 or corundum grains.

The papers used in the state of the art generally have a weight above 70 g per square metre. If the above-mentioned value is not reached, the paper is not sufficiently resistant to tearing in order to be able to handle the mechanical loads imposed during production of the tiles. The paper is furthermore so thin that it is too transparent to be capable of being used as patterned paper.

It is true that a high weight of paper has the drawback that the consumption of material is correspondingly high. In this connection it is not only the actual weight of the paper that has to be taken into account

but also the resin with which the paper is impregnated in order to be able to start the production of a tile. The higher the weight of the paper, the more resin is required for impregnating the paper. The cost of manufacture of the paper is correspondingly increased.

In order to obtain a thin paper which is resistant to tearing, a synthetic resin mixture is painted onto pre-impregnated paper. This synthetic resin mixture does not penetrate the paper but represents an additional layer which is next to the paper. The underside of the paper is as a rule provided with a self-adhesive layer. The resulting paper is known under the definition "finish film" and can be stuck onto plates or tiles.

An aim of the invention is the manufacture and treatment of a paper which is substantially resistant to tearing and in appearance from the optical point of view more colour-covering in comparison with the state of the art stated in the introduction. An aim of the invention is the production and treatment of economical tiles or plates in which the paper according to the invention is employed.

According to the method the paper is impregnated with an acrylate-containing dispersion or mixture. In comparison to an impregnation which is performed only with a resin, the paper impregnated in accordance with the method is substantially more resistant to tearing. The paper can have a weight per unit area of for example 30 g/m² and despite this is capable of handling the mechanical loads imposed in the production of a tile in the manner stated in the introduction. In fact tests have shown that the mechanical strength of the paper according to the invention is so high that the speed of impregnation in the resin-impregnation stage provided for production of the tiles can be raised from the current 40 to 60 m/min to 120 m/min. Correspondingly small - in

comparison with the state of the art cited in the introduction - is the consumption of the paper material and impregnating medium.

The acrylate-containing dispersion or mixture contains water in which the acrylate particles are dispersed. Suitable acrylates are therefore those which have good dispersing qualities.

In a preferred embodiment of the invention the acrylate-containing dispersion or mixture is pressed into the paper for the purpose of impregnation. For this purpose the paper is for example conducted through rollers which are pressed together. The acrylate-containing dispersion or mixture is continuously applied to one roller. When the paper leaves the rollers the dispersion or the mixture has been pressed into the paper.

It is important that the dispersed acrylate or the mixture is not simply painted onto the paper as then the dispersed acrylate or the mixture would not have penetrated the paper or would have penetrated it insufficiently. By the pressing step it is ensured that the dispersion or the mixture penetrates into the paper and so the paper achieves the desired improved strength. Furthermore the paper is then provided with the dispersion or the mixture in such a way that during the further treatment to produce a tile additionally introduced resin does not penetrate the paper or at least does so only to a relatively minimum extent.

In a preferred embodiment of the method the paper is a de-aerated before the acrylate-containing dispersion or mixture is pressed in for impregnating. For this purpose the paper is steeped in particular on one side with the acrylate-containing dispersion or mixture. In this way the air present in the paper is replaced by the dispersion or the mixture.

In one embodiment of the invention a resin-acrylate mixture or dispersion, in particular an amino-resin-acrylate mixture is used for the impregnation. With such a mixture or dispersion weights of paper to a lower limit of about 15 g per square metre can be achieved. Papers produced in such a way are, with a suitable mixture ratio, sufficiently resistant to tearing in order to be able to be employed in the production of tiles for example as a printed base paper. It can be left to the expert in the art to find out suitable mixture ratios by conducting a few tests.

The paper should not exceed an upper limit of 60 g/m², preferably 40 g/m², in order to achieve sufficiently high cost advantages. Optimum values currently lie between 25 and 35 g/m².

In a preferred embodiment of the invention colour pigments, for example aluminium silicate, calcium carbonate, TiO_2, Al_2O_3 or magnesium silicate are added to the mixture. In this way the translucency is greatly reduced.

The paper impregnated with the use of colour pigments can be very well introduced as the patterned paper because of its opacity to light and high covering ability.

In one preferred embodiment of the invention the acrylate-containing dispersion or mixture is pressed into the de-aerated paper from both sides. It has been found that the paper is then filled out from the middle with the acrylate-containing dispersion or mixture. Such impregnated paper is suitable in a particularly good manner for the production of the tiles mentioned in the introduction.

The paper produced in accordance with the method is distinguished from the finish films in a particular by the fact that the acrylate is present in the paper and not simply wholly or largely on the surface. The resistance

to delamination is substantially greater than in the finish films mentioned in the introduction, as steam tests indicate. In the steam test paper is exposed to steam for two hours. In conventional papers delamination takes place, in contrast to that according to the invention.

The paper which is claimed can then be introduced as counter-pull paper or patterned paper in the production of a tile in the manner stated in the introduction.

In one embodiment of the method patterned paper is provided on one side not only with abrasion-resistant particles such as silicon carbide or corundum particles, but in addition with fibres and/or spheres. The fibres or spheres, in contrast to the abrasion-resistant particles, comprise soft materials such as polyester, polyamide or glass. The fibres and/or spheres protect a pressing belt from damage during the pressing of a laminate system which includes the patterned paper. It is possible to dispense with the provision of an overlay above a layer of abrasion-resistant particles. In this way it is possible to save around one third of the costs which are involved in the impregnation of the patterned paper as well as the application of a layer with the overlay in the state of the art.

The impregnation of the patterned paper includes in particular the following steps. The patterned paper is steeped in resin, in particular amino resin and abrasion-resistant particles are applied to one side having the pattern. Subsequently the fibres and/or spheres are applied to this. The result is achieved that the fibres and/spheres form a protective covering layer over the abrasion-resistant particles in a press.

Before the application and of the fibres or spheres the process can be performed as follows.

A layer of an amino resin with abrasion-resistant particles in a special dispersion is sprayed onto the patterned paper in addition, whereby the final weight per unit area - in relation to the dry weight of the raw paper - amounts to 100% to 250%. Spraying on the dispersion has been found to be advantageous, as can be seen from the publication WO 00/44984. It is subsequently advantageous to secure the sprayed-on dispersion by smoothing and uniform distribution using rollers.

The above-mentioned dispersion preferably comprises 100 parts of an amino resin, 20 to 95 parts of abrasive, and therefore abrasion-resistant, material, 0.5 to 2.5 parts of a silane adhesion promoter, 5 to 25 parts of a flow-promoting agent, 0.1 to 0.4 parts of a cross-linking medium, 0.05 to 0.4 parts of a separating medium and of an amino resin hardener.

As the amino resin in particular a melamine resin is used, as flow-promoting agent for example polyglycol ether, ε-caprolactam or butanediol and an abrasive substance, for example silicon carbide having an average particle size of 60 to 160 μm or aluminium oxide in the form of corundum or out of the melt with a particle size of 60 to 160 μm. Also any desired mixture of silicon carbide and aluminium oxide can be provided.

The subsequent application of fibres and/or spheres preferably takes place as follows. A mixture of a resin with the fibres or the spheres is produced and the mixture is applied to the patterned paper in the manner described above. The provision of a mixture further improves the protection in a press, as then also the additional resin assists in the protection.

The thicknesses of the fibres or the diameters of the spheres are preferably chosen so that during the pressing of a corresponding laminate system for producing tiles the corundum or silicon carbide particles are kept away from the corresponding surface of the press. In this way damage resulting from hard silicon carbide or corundum particles is avoided.

The average diameter of the spheres is preferably greater than the average diameter of the fibres when both fibres and spheres are used. The spheres then ensure the desired protective spacing between the abrasion-resistant particles and for example a press belt. The fibres in particular ensure securing of the resin and oppose the formation of tears.

The respective active surface of a press is protected by the invention in an improved and particularly economical manner from damage by abrasion-resistant particles, for example hard corundum or silicon carbide particles. The maintenance of the active surfaces in a press - for example a press belt of a so-called double belt laminating installation - takes place at correspondingly longer intervals of time, so that costs and production down-times associated with the maintenance schedules are reduced. Overall, significant cost savings are obtained.

Typical fibre lengths amount to at least 0.5 mm, but preferably at least a few millimetres, for example 2 mm, 4 mm or 5 mm. The longer the fibre, the better it is able to protect the surface of a tile from the formation of tears. An upper limit on the fibre length is provided in particular by the associated rise in viscosity. In the case of a resin-fibre mixture having too high a viscosity it can no longer be worked. The diameter of the fibres lies for example at a few tens of μm or even 100 μm or more.

A typical diameter of the spheres lies between 30 and 200 μm. Thereby on the one hand the desired spacing is achieved between the corundum or silicone carbide particles and a corresponding surface in a press. On the other hand the spheres are small enough not to be perceived by the naked eye.

The optical impression is not adversely affected by the fibres or spheres if they have the stated sizes and are embedded in the resin.

The fibres or spheres are preferably made of polyester, polyamide or glass. These materials meet the characteristics which are needed during production as well as after manufacture. During production they are sufficiently stable in their behaviour. Polyesters, polyamides or glass are sufficiently soft materials in the sense of the invention in order to avoid damage to a pressing device. In a finished tile a sufficient transparency is given by the stated materials so that the optical impression of the pattern is not adversely affected. The materials preferably make possible relatively large workable fibre lengths which significantly exceed the lengths of fibres made of cellulose employed according to the invention. The rise in viscosity with increasing fibre length of synthetic polymers such as polyester fibres, polyamide fibres or glass fibres is in fact small in comparison with the increasing fibre lengths of cellulose fibres.

Accordingly sufficient fibres can be introduced whereby a press is better protected from damage in comparison with short cellulose fibres. This is particularly the case when the fibres are present in the form of a fleece, as set out further below.

The fibres and/or spheres can be made of various materials. Thus for example polyester fibres, polyamide fibres and glass fibres can be employed equally well.

Fibres are preferred to spheres as in this way the formation of tears in the surface is avoided. Spheres are therefore preferably used as a back-up. Accordingly, as spheres preferably use is made of hollow balls of glass for reinforcing the protective action, the balls in particular having a diameter of 30 to 200 μm for the reasons mentioned above.

The patterned paper claimed preferably has a solids content weight of 25 to 35 g/m^2. The fibre content then amounts in particular to 5 to 100 g/m^2. In addition for the reinforcement preferably up to 80 g/m^2 of spheres, in particular microglass hollow spheres, are provided.

In a further preferred embodiment the fibres are present in the form of a fleece. The fibres are so-to-speak woven into one another. A fleece reinforces and protects in a particularly effective manner. The danger of the formation of tears is further reduced and thereby the danger of damage to the respective engaged surface. In the application of a resin-fibre mixture the resin is a particularly well secured by the fleece during pressing. The resin then assists particularly well in the protection in a pressing device.

In the case where a fleece is provided, the protective action is further improved by the introduction of spheres.

The invention is further explained in conjunction with the following example:

Paper having a weight of 30 g/m^2 is moistened on one side with an acrylate-containing dispersion. The dispersion contains the following components: 770 g of a commercially available acrylate dispersion having a solids content of 50 % by weight, 225 g of a commercially available

urea formaldehyde impregnating resin having a solids content of 50 % by weight as well as 5 g of a urea resin hardener. The mixture is finely agitated and brought into use.

The moistened paper is conducted through mutually pressed-together rollers. The rollers have a surface made of hard rubber. The stated dispersion is uniformly applied to the rollers and distributed uniformly on the surface with the aid of doctor blades.

The acrylate-containing mixture is present in the interior of the paper which leaves the rollers. This paper is dried and can subsequently be employed for the production of tiles.

For the production of patterned or decorated paper colour pigments in addition, and in fact 250 g titanium dioxide slurry with a solids content of 70 % by weight and 50 g magnesium silicate, are added to the dispersion. The paper is then at least as opaque as a conventionally produced paper having a weight of 70 g/m^2.

The tiles produced using the papers in the manner stated in the introduction were tested in accordance with EN 438. In this test all standard norm values were fully met. In particular the steam test was successfully completed.

The decorated or patterned paper is preferably used in the manufacture of a tile as follows. A mixture of amino resin and corundum particles is sprayed uniformly on the decorated surface. 15 g/m^2 of corundum is thereby introduced. The now wet paper web is conducted to a suspension drier. A temperature of 170°C prevails in the drier. Onto the decorated upper surface of the web which has been thus treated there is applied in a metered manner a mixture of a commercially available amino resin and

polyester fibres. The solids content of the applied material amounts to 70 g/m². The fibre content in the mixture is 30 % by weight. The average length of the fibres is 5 mm. The mean diameter is 80 μm. Subsequently a second drying step is carried out at 160°C, until the residual moisture content amounts to 7%. The decorated or patterned paper impregnated in this way is employed further in the manner stated in the introduction, in order to form a tile and in particular to form a panel for flooring. Likewise paper in accordance with the invention is used as the counter-pull paper. 150 g/m² of resin can be saved in this way in comparison with the state of the art. However the paper according to the invention also offers advantages over the state of the art even when he paper weight is very high, amounting for example to 150 g/m².